1. Introduction

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1 WHAT IS CLIMATE CHANGE ADAPTATION?

Climate change is here to stay, at least for the time being. If we stopped all greenhouse gas emissions today (which, of course, is highly unlikely), we would only see marginal changes for the better in 30 to 40 years. So we have to adapt to the changing climate. Adaptation is defined as, in human systems, ‘the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities’ and, in natural systems, ‘the process of adjustment to actual climate and its effects’.¹ For the latter, it is added that human intervention in natural systems may facilitate adjustment to expected climate.² The Working Group II report of the Intergovernmental Panel on Climate Change (IPCC) concludes that adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions. For some impacts, namely those that already show or will show in the very near future, adaptation is *the only available and appropriate response*, according to the IPCC.³ Such impacts, for instance, are:⁴

- increased water availability in some regions;
- decreased water availability and increasing drought in others;
- increased ecosystem changes (species shifting their natural range) and risk of extinction of species;
- small scale negative impacts for poor farmers and fishermen;

¹ Ch B Field et al. (eds), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change* (SREX Report) (Cambridge University Press 2012) 556.

² Ibid.

³ M L Parry et al. (eds), *Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press 2007) 19.

⁴ Ibid., Table SPM-1 at 18.

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- increased damage from floods and storms;
- increased burden from malnutrition and infectious diseases and a changed distribution of some disease vectors such as the mosquitoes vectoring malaria and dengue.

The 2012 special report of the IPCC *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* adds more recent data and some more impacts:⁵

- extreme events will have greater impacts on sectors with closer links to climate, such as water, agriculture and food security, forestry, health, and tourism;
- in many regions, the main drivers of future increases in economic losses due to some climate extremes will be socioeconomic in nature;
- increases in exposure will result in higher direct economic losses from tropical cyclones;
- disasters associated with climate extremes influence population mobility and relocation, affecting host and origin communities.

The drafters of the 1992 UN Framework Convention on Climate Change (UNFCCC)⁶ treated mitigation and adaptation as being equally important. The UNFCCC mentions adaptation as one of the policies and measures to mitigate the adverse effects of climate change (Art. 3(3)). Under the commitments listed in Article 4 of the UNFCCC there are several that deal with adaptation. Adaptation, however, received much less attention than mitigation in the 20 years that followed the signing of the UNFCCC. This not only goes for policy and legal measures taken on the basis of the UNFCCC, and regional and national implementation thereof, but also for academic research.

Perhaps the lack of attention is one of the reasons why adaptation measures are still in their infancy. It appears to be much more difficult to devise and implement adaptation policies than it is to devise and implement mitigation policies. Partly this is due to the fear that attention to adaptation measures will make it more difficult to get mitigation

⁵ Field et al., above note 1 at 16.

⁶ United Nations Framework Convention on Climate Change (New York, 9 May 1992), (1992) 31 ILM 849, entered into force 21 March 1994.

measures adopted and implemented and promote a defeatist mentality.⁷ Partly, the problem with adaptation is that you cannot always take one-size-fits-all measures. Some of the consequences of climate change, particularly sea level rise, are similar in all regions of the world. Mostly, however, the consequences of climate change may dramatically differ from one region to another. Some regions suffer from droughts, whereas others face increased floods. This may be so even within one country, such as, for instance, in big countries like the USA, China and Australia. It may even be so that within the same region, periods of extreme droughts are followed by a period of intense rainfall causing floods. The biggest problem, however, is an inherent difficulty of adaptation law and policy. Whereas mitigation measures primarily can be implemented in one policy field (that of environmental law), adaptation measures have to be implemented through a wide range of policies such as water, marine and coastal, fisheries, biodiversity, energy, building and construction, agriculture, telecommunications, and infrastructure, etc. It requires an immense, coordinated effort, to adapt all the policies and laws in these fields in such a way that the society at large will be prepared for the climatic changes and associated extreme weather events that we are going to experience in the course of the twenty-first century, with a peak expected between 2050 and 2080.

What kinds of measures should we think of? Probably one of the most advanced adaptation plans that exists today, the 2010 report by the New York City Panel on Climate Change (NYPCC), gives a good overview of the measures that should be taken in a modern metropolitan area like New York City. They include, for instance:⁸

- zoning, environmental, water and waste regulations to manage precipitation, flooding and stormwater, to ensure sustained water supply and to protect wastewater infrastructure;
- zoning and land use regulations dealing with sea level rise and storm surges;
- laws and regulations aimed at facilitating increased energy demand during heat waves and designating public buildings that can serve as emergency cooling centres in heat waves;

⁷ Katherine M Baldwin, 'NEPA and CEQA: Effective Legal Frameworks for Compelling Consideration of Adaptation to Climate Change' (2009) 82 Southern California Law Review 769, 783.

⁸ As discussed by E Sussman et al., 'Climate Change Adaptation: Fostering Progress through Law and Regulation' (2010) 18 N.Y.U. Environmental Law Journal 55–155.

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- laws and regulations enabling the development of new power generation resources, and encouraging siting of emergency power generators to supply energy when there is a peak in demand (during heat waves) or in case of a weather-induced electric outage;
- laws and regulations requiring upgrading underground energy and telecommunications infrastructure to withstand flooding and sea level rise;
- various environmental impact assessment regulations requiring assessment of the consequences of the proposed activity on adaptation to climate change;
- amending energy, building, and sewer codes to adapt buildings to high wind conditions, flooding, and high temperatures;
- requirements on green or energy-smart landscaping, leading to energy consumption reductions in buildings, stormwater retention, and tree shading;
- requirements on adapting the transportation infrastructure to deal with flooding, saltwater damage, increased power demands and power outages, overheating of subway platforms, increased stress on infrastructure because of higher temperatures;
- air quality requirements dealing with more frequent periods of elevated concentrations of ground-level ozone, as well as elevated ozone concentrations;
- requirements on waste management sites and brownfields to prevent containment leaking in case of flooding and sea level rise;
- improving laws and regulations concerning emergency preparedness to be able to deal with storm surges, inland flooding and heat waves during summer.

This list deals with just the specific situation in New York City. Other cities around the globe will face other challenges. Coastal defence systems may have to be reinforced or even re-created from the start, for which land reclamation or expropriation of current land owners may be in order; negative impacts on coastal habitats will have to be minimized or mitigated. Parts of a city may even be moved to floating platforms. Other cities may not have the capacity and funds to adopt the kinds of measures New York City is adopting and may have to divert to much more drastic measures such as abandoning parts of the city or the entire city altogether. The same goes for rural areas that are below or on sea level or rural communities that have to cope with increasing droughts in addition to other stresses such as extreme poverty, land degradation, or a large number of HIV/AIDS infections. Bangladesh and parts of southern Africa are the cases in point for situations like this. Mass displacement

and mass migration, both internally and cross border, are direct consequences which in turn may lead to food shortages, lack of adequate housing and jobs, and violence between migrants and the existing population. Current international refugee law clearly is not at all equipped to deal with these so-called climate refugees and their problems.

Outside the city, a wide range of adaptation measures are necessary. In order to protect biodiversity, policies should be aimed at making protected areas climate proof by making sure that these areas are large, robust, stable, and interconnected enough to adapt to the changing climate. Protected areas should be able to live through occasional flooding, wild fires, and extreme weather events, such as heavy storms. They should have enough variety in habitat types to host new species in search of a more suitable new climate zone. Current biodiversity law, both at the domestic and at international level, is hardly able to provide for these kinds of measures. In addition, in most legislatures, biodiversity law is aimed at specific 'flag species'. However, as a consequence of climate change, species are appearing and disappearing within just a few years, rendering the idea of having a specific flag species for a certain site useless.

Measures in the field of planning law and water law may be necessary to deal with the increased risk of inland flooding. Land may be designated to serve as controlled flooding areas (or flood control reservoirs) to protect more sensitive parts of the land against flooding. Land may also have to be designated for fresh water storage, so as to have buffer capacity in times of drought. In those regions with increased winter precipitation and increased risk of drought during summer, such as will be the case in northwestern Europe, farmers may have to store fresh water on their agricultural lands in winter, to be used in summer. It is obvious that here agricultural policies and water policies are closely interlinked, as water in controlled flooding areas, which are often agricultural lands, can be used for this purpose. Farmers may even engage in recreational activities in summer with water thus stored on their lands.

The agricultural sector will also have to adjust crop variety depending on the changing climate and weather conditions. In those areas of the world where local agriculture is essential for local food production, the government will have to intervene in order to keep or restore food security. The kinds of measures that have to be taken vary greatly throughout the world. Farmers may have to shift to crops that are better suited in a wetter, or dryer, or warmer climate, or crops that are better suited in an environment of increasing salinity. More or less the same

goes for the forestry sector. The fisheries sector will have to get used to regular adjustments of fish quotas due to climate change induced decreased fish stocks. The surplus of water on agricultural lands described above may foster the introduction of aquaculture on agricultural lands.

Planning law and building law are among the fields of law that are applied by government authorities seeking to reduce potential harms from wild fires in those areas that are prone to increasing risks of bush fires.

Climate change is not only impacting government policies in the fields mentioned above, but also has a direct impact on private actors and thus on private law. Insurance companies are assessing the consequences of climate change for their line of business, the tourist industry is shifting its focus to new, yet to be developed, areas, and law firms are setting up climate litigation divisions as the number of law suits is likely to increase with the increasing damage by climate change and with increasing adaptation costs. With the increase of court cases, it is clear that litigation law, insurance law, and even property law, are affected by climate law and are, in a way, adapting to climate change as well.

2 CATEGORIES OF ADAPTATION

In literature and policy documents, various forms of adaptation are distinguished. One of these distinctions is autonomous adaptation (also called passive or spontaneous adaptation) versus planned adaptation (also called active, or directed, adaptation). Autonomous adaptation is defined by the IPCC as adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems.⁹ An example of this is earlier migration back to the breeding grounds of migratory birds (or even migratory birds that stop migrating altogether), or, in a human development context, developers in the recreation sector starting hotels and restaurants in areas that have become more suitable for mass recreation. Autonomous, or passive, adaptation most likely is unsuitable to address climate change impacts because ‘adaptations to slowly evolving trends embedded in a noisy background of inherent

⁹ Parry et al., above note 3 at 869.

variability are likely to be delayed for decades' and may lead to maladaptations because of misperceptions about weather anomalies.¹⁰

Planned adaptation is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.¹¹ A variant of the latter form of adaptation is proactive or anticipatory adaptation, which is defined as adaptation that takes place before impacts of climate change are observed. Most of the attention is focused on planned adaptation for two reasons. First, it is obvious that autonomous adaptation has its limits and cannot be relied upon in most cases. Second, from a legal and policy point of view, this form of adaptation does not need much attention because it usually happens within existing legal and policy frameworks. Therefore, this book almost entirely deals with planned adaptation.

Adger defined three 'cornerstones' of planned adaptation: reducing the sensitivity of affected systems (example: crop change); altering the exposure of systems to the effects of climate change (example: increase hazard preparedness); and increasing the resilience of social and ecological systems (example: green buildings).¹² Often, however, increasing resilience is used as the general goal of planned adaptation, as also seems to be the case in the definition of that term offered by the IPCC: resilience is 'the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions'.¹³

Another form of adaptation that should be mentioned here is maladaptation. The Organisation for Economic Co-operation and Development (OECD) defines maladaptation as 'business-as-usual development which, by overlooking climate change impacts, inadvertently increases exposure and/or vulnerability to climate change. Maladaptation could also include actions undertaken to adapt to climate impacts that do not succeed in

¹⁰ Stephen H Schneider and Janica Lane, 'Dangers and Thresholds in Climate Change and the Implications for Justice' in W Neil Adger et al., *Fairness in Adaptation to Climate Change* (MIT Press 2006) 46.

¹¹ Ibid.

¹² W Neil Adger, Nigel W Arnell and Emma L Tompkins, 'Successful Adaptation to Climate Change across Scales' (2005) 15 *Global Environmental Change* 77, 79.

¹³ Field et al., above note 1 at 563.

reducing vulnerability but increase it instead.¹⁴ An example is the construction of elevated roads so as to make them resilient to floods, which consequently, however, trigger new development in a zone that is vulnerable to flooding.

The opposite of maladaptation is successful adaptation.¹⁵ The success of adaptation measures is not easy to assess, as adaptation measures may be successful in the short term, but not in the long run, or may be successful in one location but have negative side effects in another location, for instance downstream.¹⁶ Important factors for success are not only the effectiveness of measures, but also their efficiency and equity and legitimacy.¹⁷ The latter, typically, are for a large part determined by the legal framework for adaptation policies and, therefore, are central to this book.

3 LINKS BETWEEN ADAPTATION AND MITIGATION

Adaptation cannot be regarded in isolation from mitigation. Not only are they both important elements of any climate change policy,¹⁸ they are also positively and negatively interlinked. First, many adaptation measures equally serve mitigation goals. Afforestation, reforestation, and preserving and restoring mangroves, with the goal to protect the land against flooding, against landslides following intense rainfall, or against the negative impact of storms, are all measures that can also be part of a mitigation strategy. The same goes for adaptation measures in the field of biodiversity conservation. Creating corridors between protected areas and enlarging protected areas through restoration lead to an increase in vegetation, and thus to additional carbon uptake. This is even true for the construction of green buildings and green roofs: not only are they naturally cooler and thus an effective measure against heat waves, they also lead to less energy consumption and, again, to additional carbon uptake. In fact, any measure to reduce the amount of energy consumption

¹⁴ OECD, *Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance* (Paris: OECD Publishing, 2009) 53.

¹⁵ See extensively Susanne Moser and Maxwell Boykoff, *Successful Adaptation to Climate Change: Linking Science and Policy in a Rapidly Changing World* (Routledge 2013).

¹⁶ Adger et al., above note 12 at 80.

¹⁷ Ibid. at 82.

¹⁸ W Neil Adger, Irene Lorenzoni and Karen L O'Brien, 'Adaptation Now' in W Neil Adger, Irene Lorenzoni and Karen L O'Brien (eds), *Adapting to Climate Change: Thresholds, Values, Governance* (Cambridge University Press 2009) 4.

to avoid an energy fall out during heat waves is also a mitigation measure.

The second link between adaptation and mitigation is a negative one. Adaptation measures can be harmful to the climate in the sense that they lead to: a) more greenhouse gas emissions; or b) a reduction of carbon uptake. The examples are obvious. Installing air conditioners to combat the heat leads to more energy consumption and thus, if the energy comes from a coal-fueled energy installation, to higher emissions. Replacing a natural coastal habitat by a large sea wall to combat sea level rise and storm surges leads to a loss of natural carbon uptake. This example, coincidentally, shows that an adaptation measure in one policy field may be detrimental to adaptation policy in another field, as the large sea wall that replaces natural coastal habitat probably will lead to a loss of biodiversity adaptation opportunities.

Mitigation measures, on the other hand, can be harmful for adaptation as well. Afforestation in arid and semi-arid regions strongly reduces water yields and thus has a negative impact on local agriculture and biodiversity. Switching to hydropower may reduce irrigation options for farmers and thus deprive them of adaptation opportunities.

It is clear that adaptation and mitigation policies have to be developed together, so that they are mutually beneficial.¹⁹ Therefore, although this book focuses on adaptation law, we cannot and will not ignore mitigation law.

4 DEALING WITH RISKS AND UNCERTAINTY AND OTHER BARRIERS TO ADAPTATION

Although thousands of scientists around the globe have been researching climate change for many years now, we are still faced with many uncertainties. Uncertainties as to the exact nature and intensity of the changes that we can expect, the timeframe within which they are to be expected, and the locations that will be hardest hit. Uncertainties present

¹⁹ See extensively chapter 18 of the IPCC's Working Group II report: R J T Klein et al., 'Inter-relations Between Adaptation and Mitigation' in M L Parry et al. (eds), *Climate Change 2007: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press 2007) 745–777.

themselves in two ways: a) uncertainties caused by our lack of knowledge; and b) uncertainties caused by randomness inherent to the phenomenon at hand. In literature on risks, these are usually described as epistemic risks (a) and aleatory risks (b). Both types of risk are relevant in climate adaptation law and policies.

Obviously, risks inherent in the randomness of floods, storms and other events influenced by climate change will never disappear. We can only predict that in certain areas storm intensity will increase, rainfall will increase etc., without being able to tell exactly when and where a storm will hit and how strong that storm will be.

Uncertainties as a consequence of a lack of knowledge do gradually become smaller because of increasing scientific knowledge as to what is happening to atmospheric and climatic processes due to higher levels of greenhouse gases in the Earth's atmosphere. We must, however, not be so optimistic as to think that this type of uncertainty will eventually disappear altogether, at least not in the foreseeable future. Our lack of knowledge is still quite large, especially because, as a consequence of climate change, *everything* is changing. Increasing carbon emissions leads to temperature rise, which leads to a great number of subsequent changes in weather patterns. Many of these changes probably do not occur in a linear way. Instead, it becomes increasingly clear that there are many tipping point effects and non-linear effects. Such effects are much more difficult to predict. Paradoxically, increasing scientific knowledge has led to an increase in the epistemic risks. We now know better what we do not know. Our lack of knowledge also concerns the effect of these changes on human behaviour and on that of the other living organisms on Earth. How are living organisms, including human beings, going to adapt to these changes once they occur, gradually or suddenly? In addition to all of this, we should keep in mind that scientists will keep disagreeing on certain aspects of their findings. This is simply what scientists do: they question findings in order to establish a theory on the basis of which the most accurate predictions can be made. Policy makers have to deal with this 'tug of war among competing theories and qualifications of theories'.²⁰

Kleindorfer shows how both types of risks are tightly intertwined with choice. A homeowner or a business might consider options such as insurance or mitigation before the fact in order either to reduce or pay for

²⁰ Paul Kleindorfer, 'Interdependency of Science and Risk Finance in Catastrophe Insurance and Climate Change' (2010) INSEAD working paper 10, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1538161, accessed 5 October 2012.

losses resulting from an extreme weather event. In order to reach such a decision, the homeowner or business may want to gain knowledge to reduce the epistemic risk. Knowledge is thus a fundamental input to rational choice under uncertainty.²¹ The same processes take place at the macro level of state authorities making climate adaptation policies and regulations. Authorities are faced with the huge challenge of regulating for an uncertain future and with dealing with ‘low probability, high consequence events’. It requires a proactive and long term approach of policy makers and regulators; an approach in which they can rely less on front-end methodologies,²² such as environmental impact assessments, regulatory impact assessments, and cost–benefit analyses.²³ Laws and regulations have to leave room for long-term decision-making under uncertainty and still give the decision-makers the tools to reach legitimate decisions. Craig translated this approach based on information and taking long policy horizons into five principles for climate change adaptation law: 1) monitor and study everything all the time;²⁴ 2) eliminate or reduce non-climate change stresses and otherwise promote resilience; 3) plan for the long term with much increased coordination across media, sectors, interests, and governments; 4) promote principled flexibility in regulatory goals and natural resource management; and 5) accept – really accept – that climate change adaptation will often be painful.²⁵ What this means in practice in the various fields of law is the core issue in each of the chapters of this book.

²¹ Ibid. at 12–13.

²² J B Ruhl, ‘Climate Change Adaptation and the Structural Transformation of Environmental Law’ (2010) 40(2) Environmental Law 363, 416.

²³ Climate change decision-making truly shook up discussions on cost–benefit analyses because it forced us to think about how to value the benefits for future generations in today’s currency. See extensively Richard L Revesz and Matthew R Shahabian, ‘Climate Change and Future Generations’ (2010) N.Y.U. School of Law, Public Law & Legal Theory Research Paper Series, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1666423, accessed 5 October 2012.

²⁴ The 2012 climate change impacts report by the European Environment Agency has a similar recommendation: ‘On-going and planned monitoring and research at national and EU level can improve assessments of past and projected impacts of climate change, thereby enhancing the knowledge base for adaptation’, European Environment Agency, *Climate Change, Impacts and Vulnerability in Europe 2012. An Indicator-based Report* (EEA 2012) 18.

²⁵ Robin Kudis Craig, ‘“Stationarity is Dead” – Long Live Transformation: Five Principles for Climate Change Adaptation Law’ (2010) 34 Harvard Environmental Law Review 9.

It is increasingly concluded that current risk analysis and risk management practice will not be effective as a tool to provide effective adaptation as they do not necessarily lead to strategies that facilitate the required changes in existing political rationalities.²⁶ Risks of business-as-usual should be prioritized over the risks of change, and systemic changes should be targeted instead of stability.²⁷ This requires a radical departure from the conventional approach to environmental regulation, dominated by the risk regulation paradigm.²⁸

Another challenge to adaptation is that it can only be successful if adaptation governance occurs at all levels of government, as well as at the level of private parties, through multiple policy responses. Peel et al. conclude that adaptation policy and regulation need to link effectively across different levels, both horizontally and vertically, from individual or local actor responses to national laws and international treaties.²⁹ Again, this is a common feature that we find in each of the chapters of this book.

5 THE FOCUS OF THIS BOOK

What are the legal challenges and barriers to climate change adaptation and how can they be overcome? What can be done within existing legal frameworks, and where are new or adapted frameworks needed? These are the main questions that we address in this book. The book discusses all the fields of law that are faced with challenges brought about by the need to adapt to the changing climate and to extreme weather conditions: tort law, property law, insurance law, disaster law, water law, marine law, planning law, biodiversity law, building and construction law, environmental law, migration law, agricultural law, and energy law. It does so in an integrated way, which is the only way given the strong connections between these fields of law. For each field of law, the challenges and barriers to adaptation are discussed, as well as ways to overcome these barriers. The book does not focus on a specific legal system, such as that

²⁶ Nick Pidgeon and Catherine Butler, 'Risk Analysis and Climate Change' (2009) 18(5) *Environmental Politics* 670, 686.

²⁷ Veerle Heyvaert, 'Governing Climate Change: Towards a New Paradigm for Risk Regulation' (2011) 74(6) *Modern Law Review* 817.

²⁸ *Ibid.*

²⁹ Jacqueline Peel, Lee Godden and Rodney J Keenan, 'Climate Change Law in an Era of Multi-Level Governance' (2012) 1(2) *Transnational Environmental Law* 245, 275.

of the European Union (EU) or the United States,³⁰ or on a specific level of governance, such as the international level.³¹ Instead, we take a transnational, multi-level governance view, focusing both at the international, the regional, and the domestic level, using examples from around the world. While such an approach obviously does not allow discussion of the legal implications of adaptation measures for each country, it does offer an opportunity to transcend national legal specifics and thus get a better view of the main issues to be solved as well as potential solutions.

The set-up of the book is as follows. Chapter 2 first describes how the international community has been dealing with adaptation within the frameworks of the UNFCCC and the Kyoto Protocol. Chapter 3 then takes an ethical approach to adaptation by focusing on climate justice and the relationship between climate adaptation law and development. Human rights and migration law are then dealt with in Chapter 4 when focusing on climate induced displacement. Chapter 5 focuses on compensation. How can victims of climate change be compensated for their losses caused by climate change, both direct losses and losses arising out of the need to take adaptation measures? Liability law, insurance law, compensation funds, tax law, and direct compensation by the government are fields of law that are addressed here. Disaster law is the topic of Chapter 6, dealing with disaster risk reduction as an important means of making society resilient to extreme weather events and other disasters associated with climate change.

From Chapter 7 onwards, the focus will be on specific sectors: public health law (Chapter 7), agricultural and forestry law (Chapter 8), water law (Chapter 9), marine and coastal law (Chapter 10), biodiversity law (Chapter 11), land use and planning law (Chapter 12), law dealing with the built environment (Chapter 13), pollution control law (Chapter 14), and energy law, with a focus on electricity supply (Chapter 15).

³⁰ A comprehensive study of climate change adaptation law in the US is offered in Michael B Gerrard and Katrina Fischer Kuh (eds), *The Law of Adaptation to Climate Change: United States and International Perspectives* (ABA 2012).

³¹ See Rosemary Rayfuse and Shirley V Scott (eds), *International Law in the Era of Climate Change* (Edward Elgar 2012).

6 CONCLUSIONS

The contributions to this book show that, although adaptation receives a growing amount of attention, both in practice and in academia, adaptation law is only just starting to emerge. In most instances, there are some plans or policies aimed at adaptation in various fields, usually those fields that already have to deal with increasing problems, such as storm water management, and flood management. An adaptation of the laws still has to start. It is obvious that existing laws have to be assessed on their ability to facilitate adaptation. This is a huge undertaking because there is hardly any field that is not affected by climate change. All laws and regulations that in any possible way organize society have to be 'climate proofed': laws regarding agriculture, forestry, fisheries, energy and telecommunications infrastructure, water management, air quality, industrial installations, nature conservation, buildings, transport infrastructure, public health, migration, disaster management, coastal defences, etc. It is not really possible to draw more specific overarching conclusions than the ones already mentioned in this introductory chapter: every field faces specific climate change impacts and needs specific adaptations, adaptations that also need to vary according to local circumstances. In various chapters, examples are presented of how existing laws are effectively applied to create resilience or to otherwise prepare for extreme weather events or other climate change impacts. Often, though, existing legislation needs to be adapted so that the competent authorities are obliged to plan for and take adaptation measures. The EU, for example, has just embarked on an ambitious programme to climate proof all existing Directives and Regulations. In 2013, the first climate proofed piece of EU legislation is expected to be adopted (a revised Directive on environmental impact assessment). It will probably take at least ten years before the entire body of EU law has been climate proofed. Similar programmes will have to be set up at all levels of government: international, regional, national/federal, provincial/regional, and local. Since many impacts of climate change will be local impacts, and since these impacts can vary greatly from one location to another, it is important that, at the local level, the authorities take the lead in local adaptation programmes. At that level, planning law is probably the most important instrument in the authorities' adaptation toolkit. Higher levels of government have to ensure that the authorities at the local level have sufficient room for manoeuvre. For adaptation issues at the higher levels, i.e., at the level of transboundary river basins, national or transboundary coastal areas, international marine areas, regional or international migration, and

other levels, international institutions will have to take the lead and coordinate international adaptation efforts. At all levels, issues of equity and justice arise and need to be incorporated into the law-making process.